

# Mars Sample Return Overview

An artistic illustration of the Mars Sample Return mission. In the foreground, a Mars rover is on the left, and a Mars Ascent Vehicle (MAV) is on the right. In the middle ground, a Mars lander is visible. In the background, a Mars helicopter is flying. A Mars orbiter is in the upper right corner, and a small satellite is in the upper left corner. The Earth is visible in the sky. The background is a reddish-brown Mars landscape with mountains and a hazy sky.

**Joe Gasbarre**

**MSR Deputy Program Director - Technical**

*March 31, 2022*



# What is the Mars Sample Return Program?

**The Mars Sample Return Program (MSR) is an ambitious, international science mission to collect and return rock and sediment samples from the Martian surface.**

It has been a priority of the past two National Academy Decadal Surveys

It will be the first “round-trip” to another planet, paving the way for future human exploration

**MSR is a complex mission.**

Requires a set of capabilities that were not demonstrated 20, or even 10, years ago.

It is only possible today as a result of the \$10+B investment made through the formulation, technology and operational projects of the past decades, coupled with a strong international partnership with ESA.





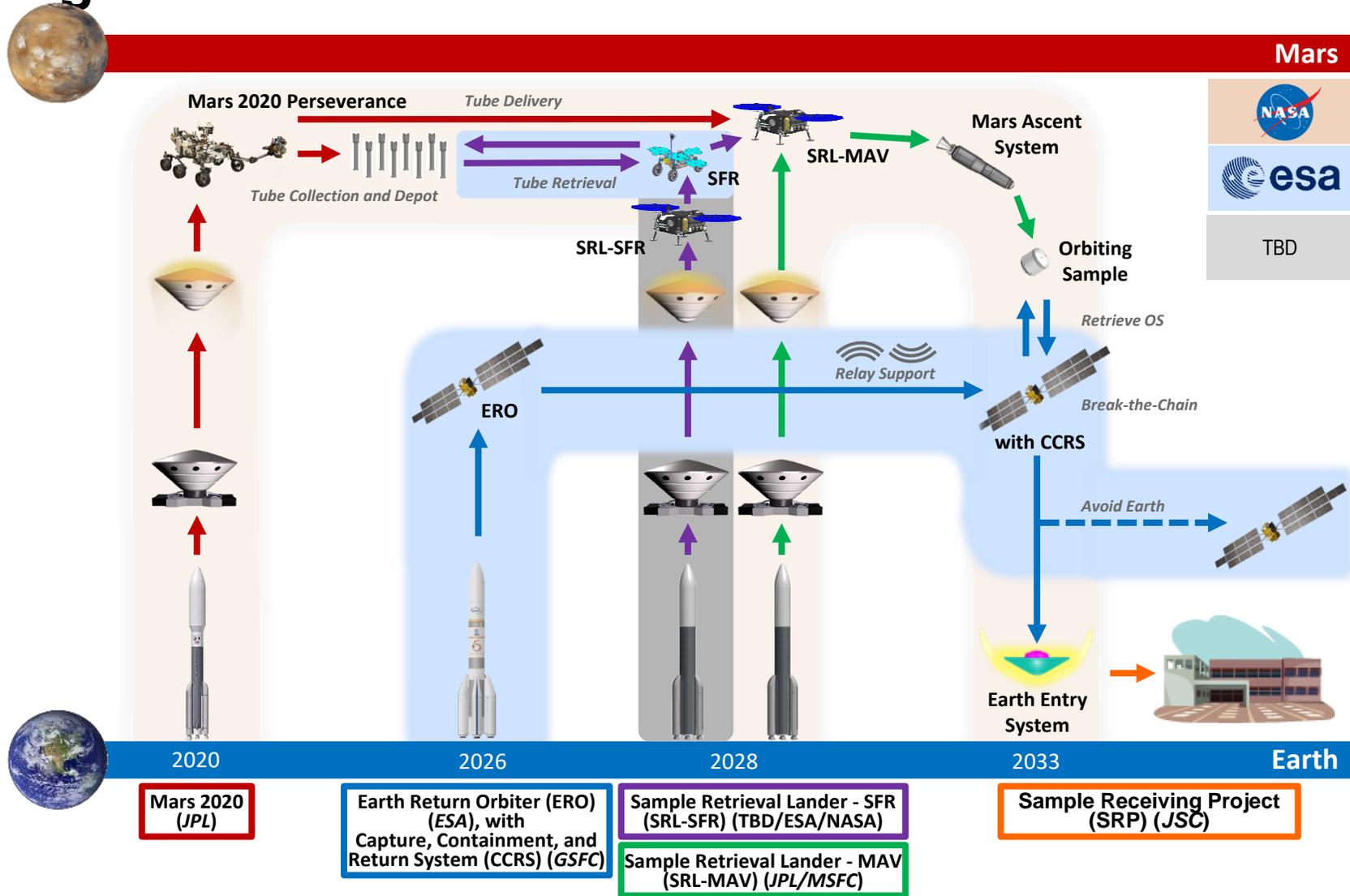
# GOAL — First Sample Return From Another Planet

A priority since 1980 and of two National Academy Decadal Surveys  
A first-step “round-trip” in advance of humans to Mars

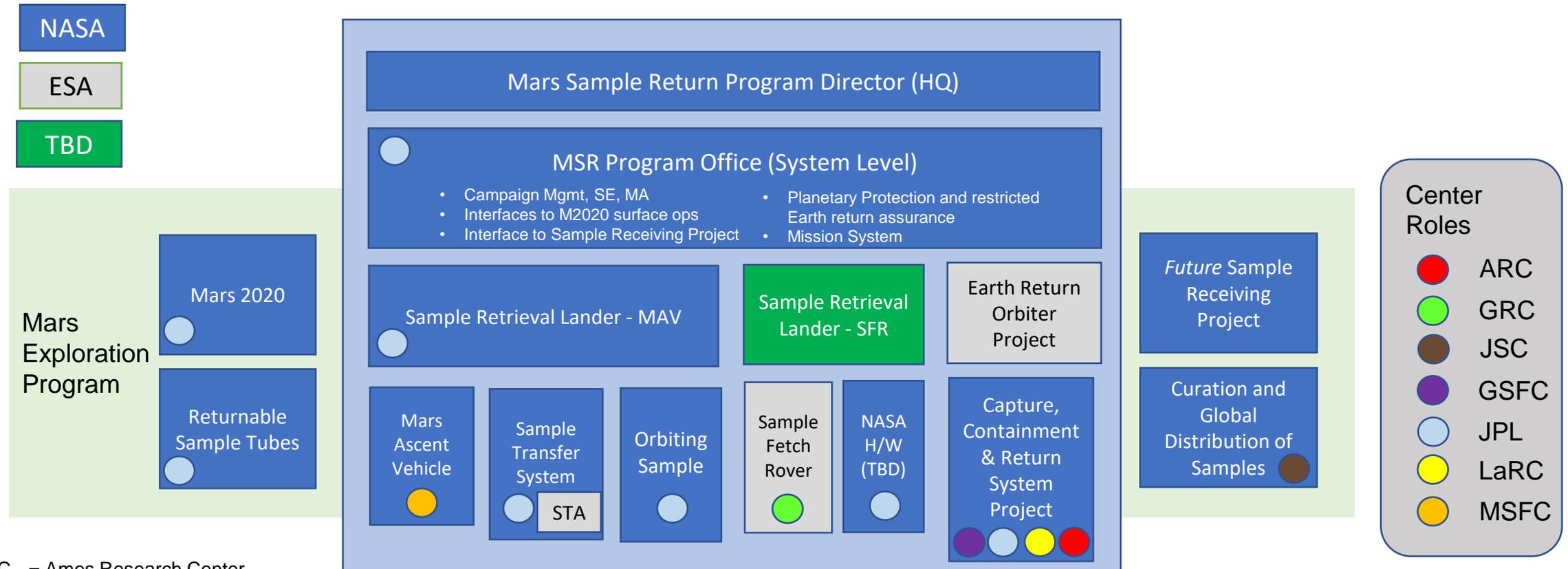
The oldest known life on Earth existed ~3.5 billion years ago,  
a time when Mars was habitable. Today,  
<<1% of the Earth’s surface is 3 billion years or older  
>50% of the Mars’ surface is 3 billion years or older

***The first billion years and life’s beginning in the Solar System:  
The record is on Mars***

# MSR Program Architecture



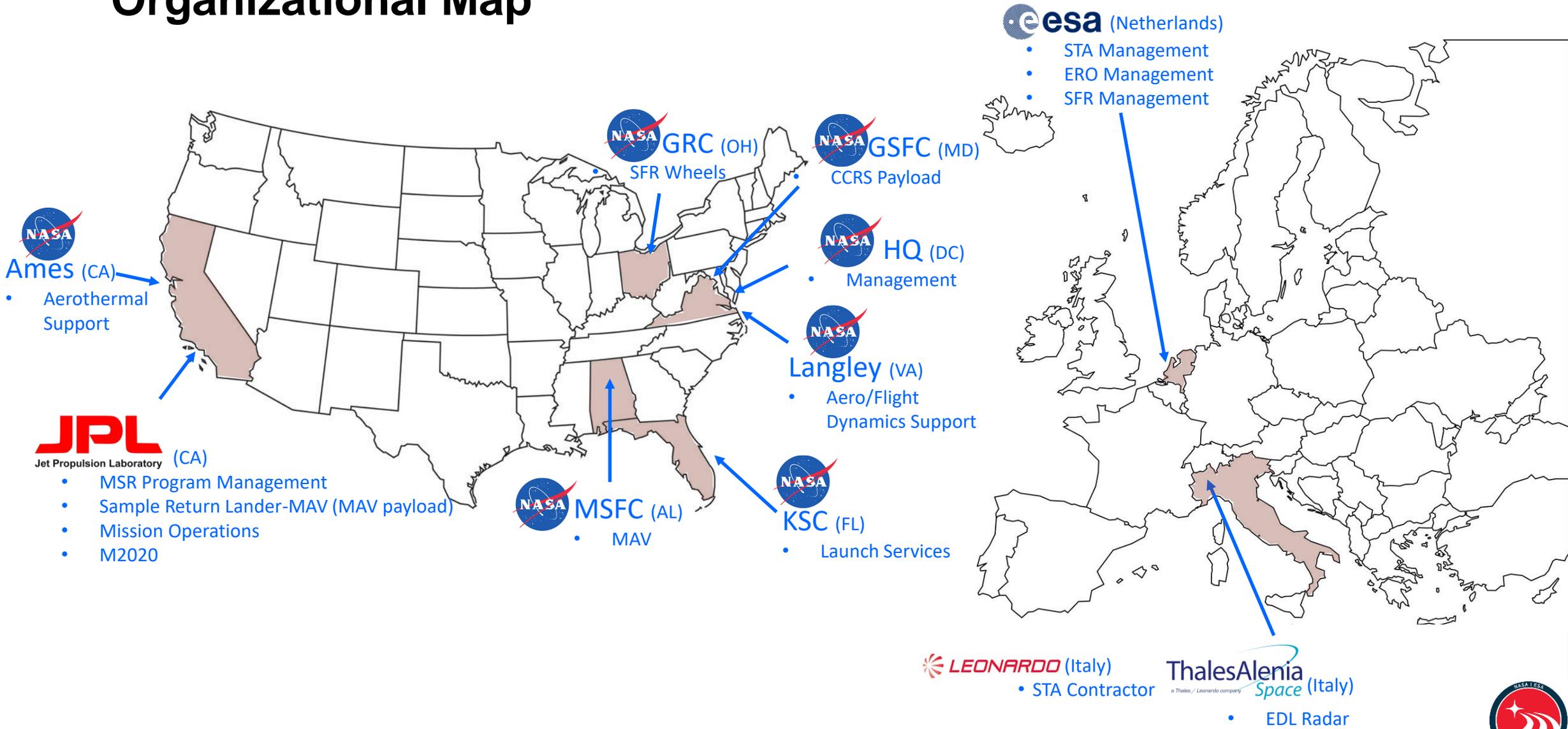
# MSR Program Structure (Agency & Center Contributions)



- ARC = Ames Research Center
- GSFC = Goddard Space Flight Center
- GRC = Glenn Research Center
- JPL = Jet Propulsion Lab (Cal Tech)
- JSC = Johnson Space Flight Center
- LaRC = Langley Research Center
- ESA = European Space Agency



# Organizational Map

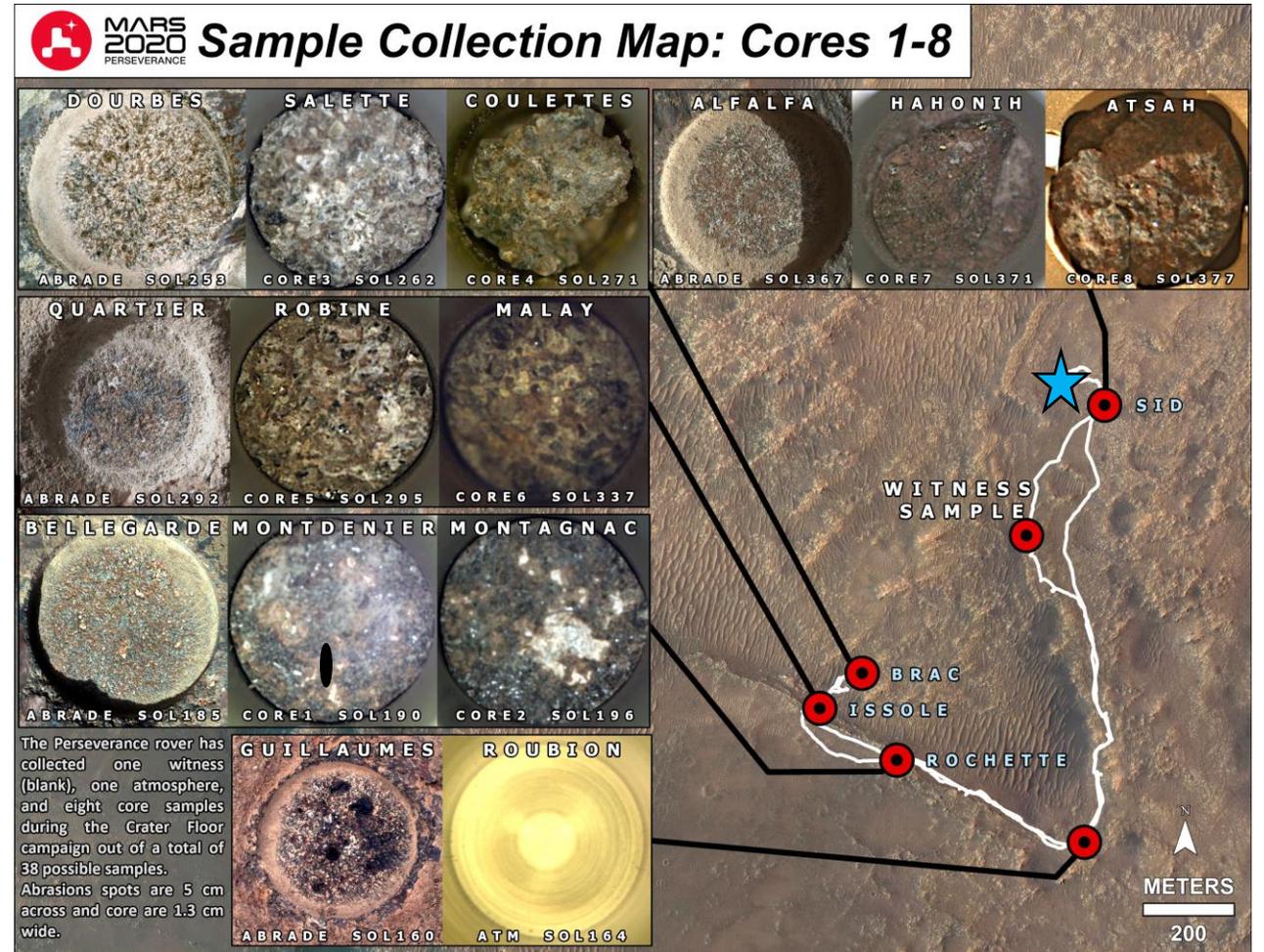


# Samples Collected by Perseverance

Perseverance completed its crater floor science campaign in mid March after collecting the 8<sup>th</sup> rock core sample near the Octavia E. Butler Landing site. The rover is now conducting a rapid traverse campaign to drive counter-clockwise around the Séítah dune area towards the Delta front.

**Total 10 tubes sealed:**  
**1 Witness blank**  
**1 Atmospheric sample**  
**8 Rock Core samples**

- ★ Octavia E. Butler Landing Site
- Sampling Sites



Courtesy of Fred Calef and M2020 team



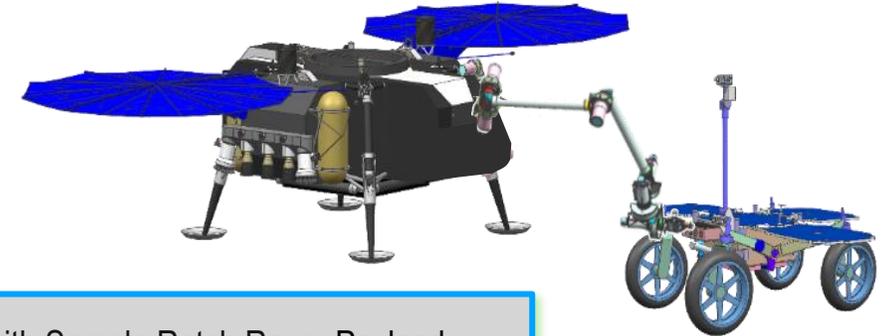
# Program Elements

## Dual Landers

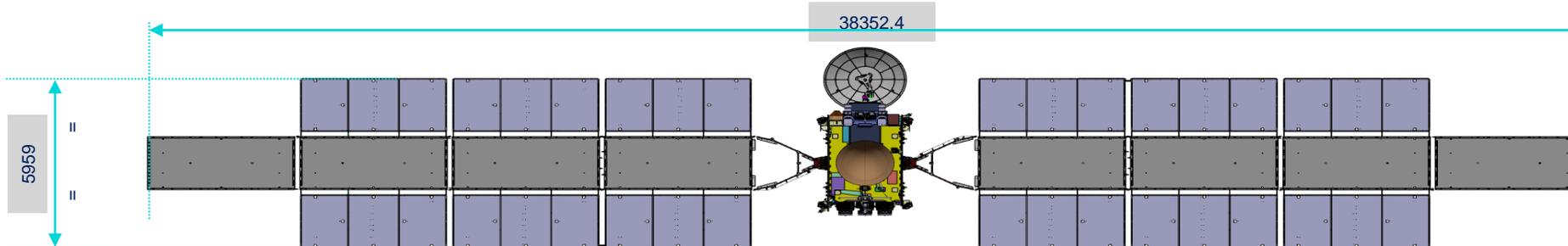
SRL-MAV with Mars Launch System Payload



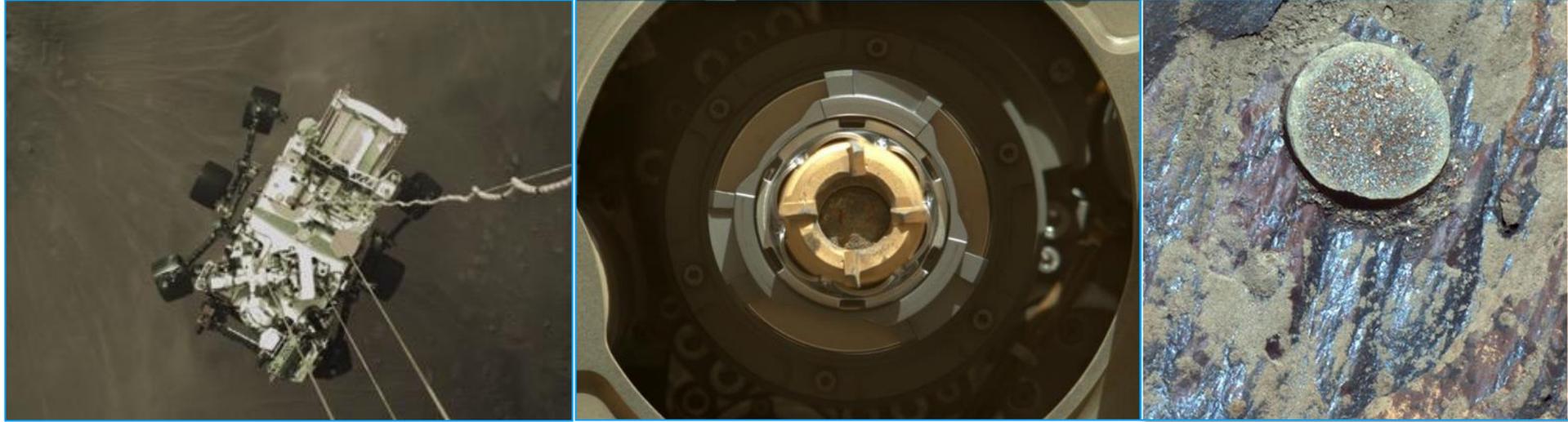
SRL-SFR with Sample Return Rover Payload



## Earth Return Orbiter & CCRS Payload



## When is the MSR Mission?



**February 2021:** NASA's Perseverance Rover landed on Mars in February 2021. It is collecting samples to be returned to Earth.

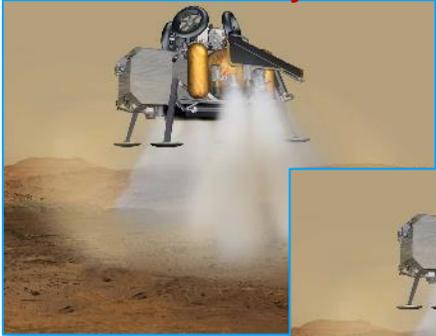
**2027:** ESA's Earth Return Orbiter will launch to Mars. Its payload is the NASA Goddard Capture, Containment, and Return System (CCRS). It will receive the Martian samples and return them to Earth.



# When is the MSR Mission (continued)?

Dual Landers Touch Down

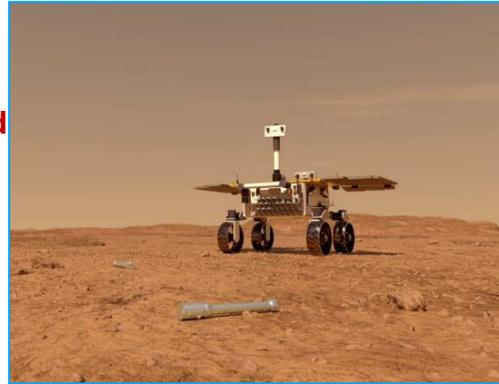
SRL-MAV: MAV Payload



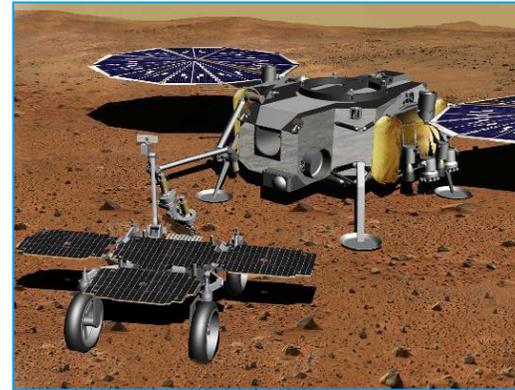
SRL-SFR: SFR Payload



The Sample Fetch Rover Exits SRL-SFR & Retrieves Sample Tubes



Fetch Rover's Tubes Are Transferred To SRL-MAV



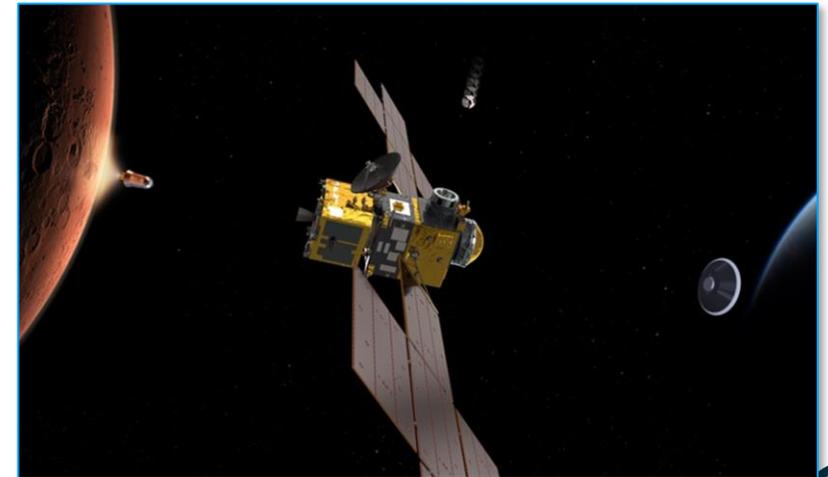
MAV Launches With Samples



**2028:** SRL-MAV (provided by NASA) and SRL-SFR (Provided by TBD) will launch to Mars.

**2030:** Samples will be retrieved and launched off the Martian surface, then captured by the Earth Return Orbiter with its Capture-Containment-Return Payload. The ERO begins its journey back to Earth.

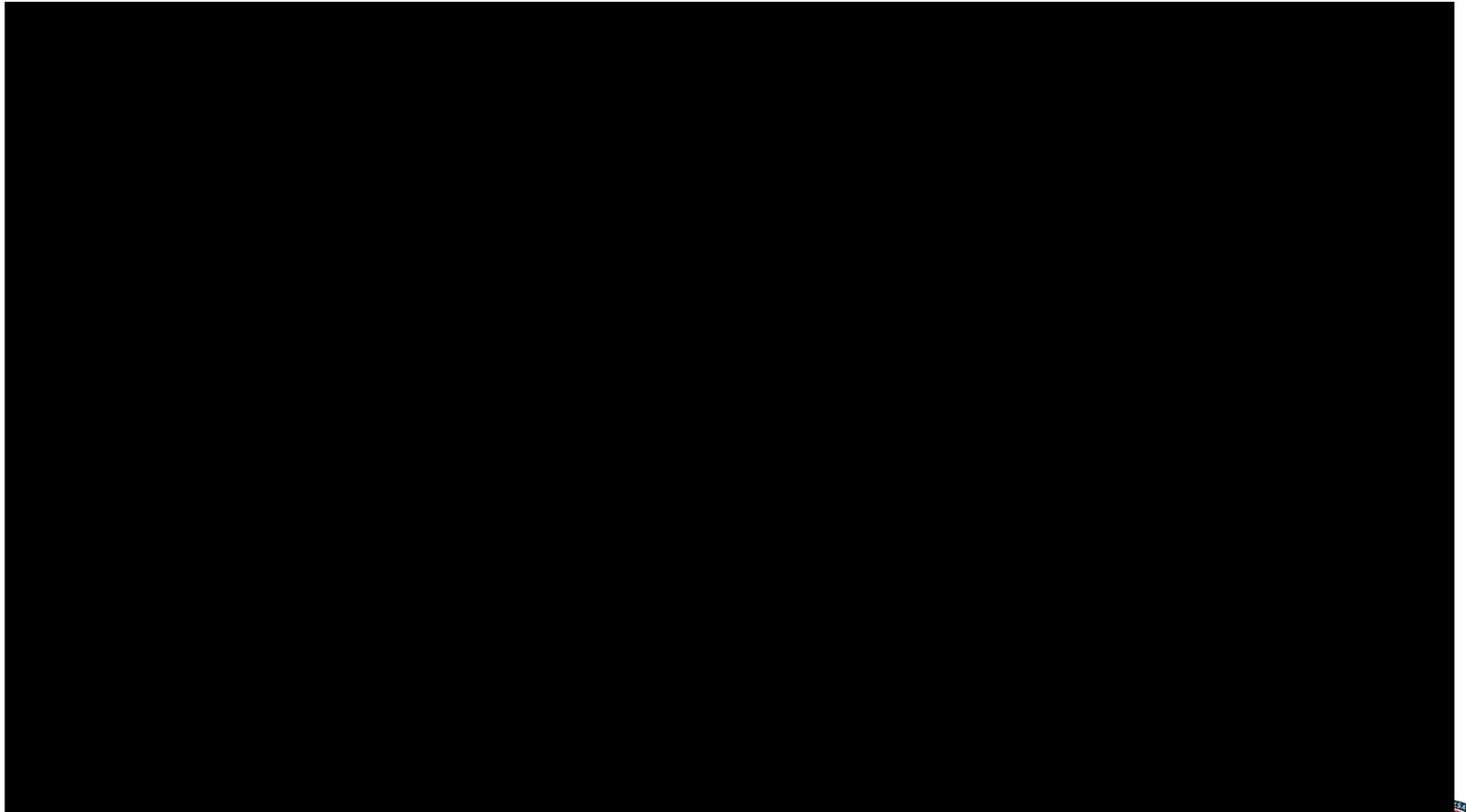
**2033:** The samples touch down at the Utah Test and Training Range. Samples are collected for scientific handling.



# Testing MSR Technology

**VECTOR = Vertically Ejected Controlled Tip-Off Release**

- VECTOR is a pre-ignition separation mechanism for the MAS
- VECTOR provides a MAS separation state with a vertical velocity and pitch rate
- MAS ignition occurs a set time after separation within an established window that allows for successful flyaway





## **EES Manufacturing Demonstration Unit #1 Drop Test**

Utah Test and Training Range March 1, 2022

NASA / USAF Team Photo



## MDU1 Drop Test Video

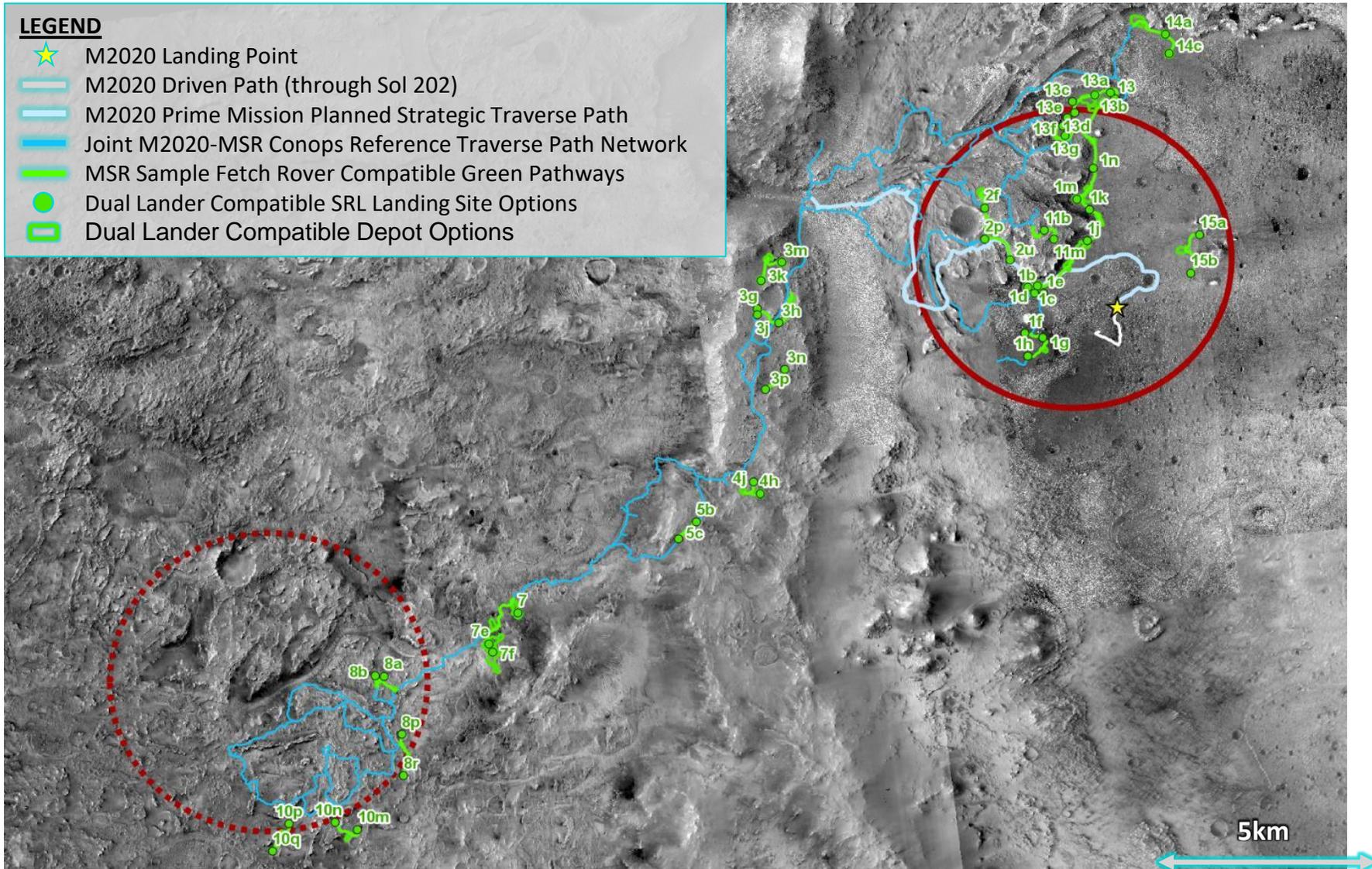
Drop Altitude: ~1000 ft

Terminal Velocity at impact: ~33 m/s

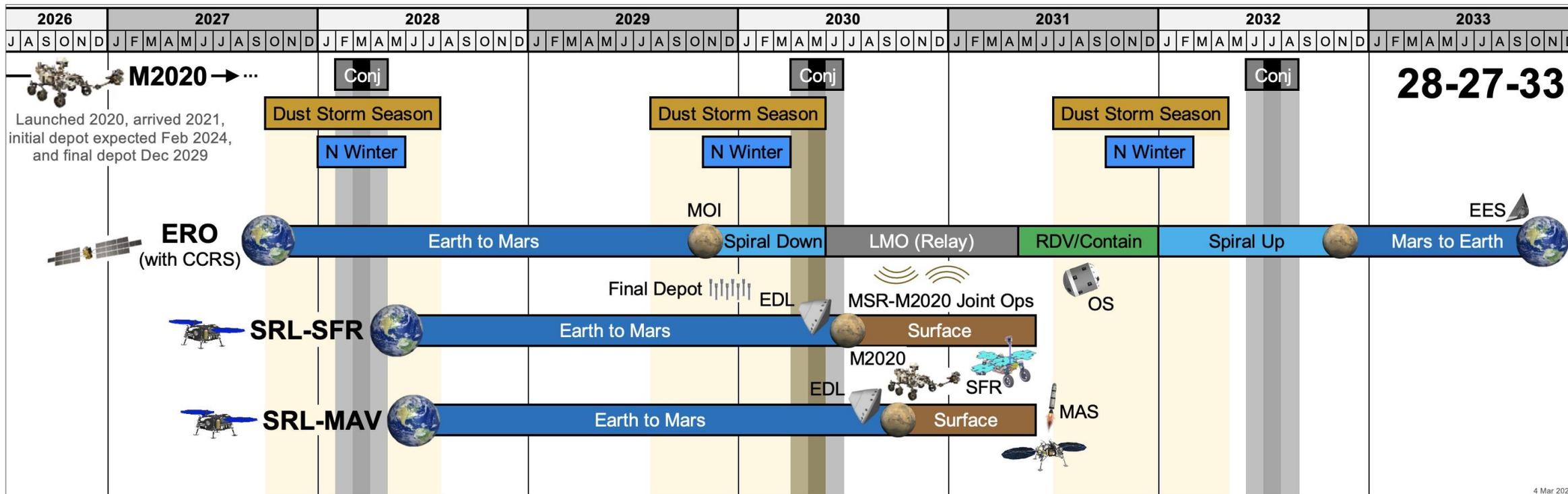
Utah Test and Training Range – March 1, 2022



# Notional MSR Dual-Lander Green Pathways



# Campaign Timeline Overview



4 Mar 2022



# Summary

- This is the most significant planetary science undertaking in a generation
- Now is the time!
  - Perseverance on surface of Mars collecting samples
  - Orbital Relay assets in place around Mars
- MSR is made possible by strong and significant partnerships with European colleagues at ESA and their industrial consortiums

